Winter Under a Microscope

In a Nutshell

Students will become field biologists using microscopes to examine microscopic characteristics of diverse winter macroscopic organisms.

Grade 4 - 6
Season Winter
Location Visitor Center

Learning Objectives

After participating in this activity, students will be able to:

- Successfully operate a field microscope.
- Explain that microscopes provide a detail view of living and non-living things.
- Give at least one example of how microscopic details help scientists identify and understand the natural world.

Literature Connections

Hidden Worlds: Looking Through a Scientist's Microscope by Stephen Kramer
Looking Through a Microscope by Linda Bullock (1040L)
Snowflake Bentley by Jacqueline Briggs Martin (AD830L)

Pre-Activities

Students will learn microscope terminology and how to properly use field microscopes while identifying "mystery slides." This activity will prepare students to properly use field microscopes during their refuge fieldtrip.

On-site Activities

Students will collect winter flora and fauna specimens found on the refuge to examine under microscopes. Using a drawing activity with these specimens, students will compare the characteristics that can be seen with only the naked eye with those apparent under a microscope.

Classroom Connection

Encourage students to write poems or stories that correlate to the drawings of their collected specimens.

Teacher Resources

Adventures with a Hand Lens by Richard Headstrom
Adventures with a Microscope by Richard Headstrom
Microscopes and Magnifying Lenses by Janice VanCleave
Discover Nature in Winter by Elizabeth Lawlor
Guide to Nature in Winter by Donald Stokes

Winter Under a Microscope
Pre-Visit Activities

Materials

- Field Microscope diagram
- Field microscopes- at least one per group of 3 students
- Hand lenses- one per student
- "Mystery Slide" set (5 slides: butterfly antennae, paper wasp nest paper, butterfly wing, dragonfly wing, snake skin)
- Photographs that illustrate: tree bud, plant seed, pollen grain, insect antennae, fish scale (if staff does not want to draw examples in the dry erase board)

Introduction

Ask students why they think biologists use microscopes? Most people think the purpose of a microscope is to look at tiny organisms that we can not see with our own eyes. Actually, many field biologists use microscopes to examine microscopic (tiny) characteristics of many macroscopic (large) organisms. Using photographs or hand drawn illustrations give the following examples:

- Some tree species may only be identified by characteristics not seen by the naked eye. What distinguishes one tree from another might be the number of scales covering a tree's bud or fine hairs on the underside of a leaf.
- A field biologist may need to look at the shape of a plant's seed or grain of pollen to make a correct identification.
- The shape of an insect's antennae may be the key feature to identify the species.
- To correctly identify the age of a fish, biologists count growth rings found on a scale.

Field Microscopes vs. Lab Microscopes

Generally, a field microscope is less powerful (provides less magnification) than most lab microscopes, they do not have multiple lenses, and only need a source of natural light. Field microscopes are often designed to collect light using a prism (like the ones the students will be using). Generally, field microscopes are smaller and easier to transport; which is helpful to quickly identify species "in the field."

Using the **Field Prism Microscope** diagram, review the parts of the microscope and how to use them. Demonstrate the proper way to hold it (by the **arm**), to secure a glass slide to the **stage plate** (using the **metal clips**), and to position and tilt the microscope (so that the **prism** catches the most light).

Now demonstrate how to focus by *gently* moving the microscope **focus tube** up (away from the slide) or down (closer toward the slide) until the specimen is in view. When the specimen is in view, bring it into clear focus with gentle, smaller adjustments closer or farther from the slide. Ask students to avoid touching the **viewing lens** at the top of the **eye piece** and be careful not to pull the entire cylinder, or the **eye piece** out of the microscope.

Field Prism Microscope

Identifying Mystery Slides

Divide students into teams of 3 or less. Give each team a microscope and set of mystery slides. Each member of the team should practice placing a slide to the microscope stage using the metal clips and then bringing the specimen into view. When every member of each team has had a chance to look at each slide, ask them to write down their best guess for the identity of each specimen. After the class has had a chance to view all 5 mystery slides, review and compare their guesses to the correct answers.

1. Butterfly Antennae
The clubbed, scaled end is characteristic of butterfly feathery. Moth antennae are usually feathery. There are no hairs like this seen on the grasshopper leg.

2. Paper Wasp Nest
The wasp's paper show rings of darker and lighter gray from the bark they chewed on and spit out to make their nest.

3. Butterfly Wing
To the naked eye, the wing appears covered in a powdery dust; but under a microscope, this dust is clearly overlapping scales.

4. Dragonfly Wing
Clear scales cover the wing of the dragonfly.

5. Snake Skin
Transparent, these scales protect the snake from injury as it moves across the ground. Diamond shaped scales are found on top the snake. Rectangular belly scales also increase traction so the snake can move across the ground.

Wrap-UP

Discuss with students that during their field trip to the national wildlife refuge, they will be collecting items in nature and bringing them back into the classroom to view through microscopes. Remind students to wear warm winter clothes (jackets, boots, snow pants, gloves, hats) as there will be outside activities. The field trip will be on snowshoes if there is enough snow.

Winter Under a Microscope
On-site Activities

Materials

- Field Microscopes- one per student pair
- Student Journal Page - one per student
- Hand lens- one per student
- Collecting kits – one per student team: ziploc bag containing a collecting list, tweezers, and petri dish
- Colored pencils- at least one package per student team
- Compound microscopes- 4
- Set of labeled compound microscope slides (salt, pollen, mouth smear, paramecium)

Introduction

Inside Visitor Center (30 minutes)

Welcome students to Minnesota Valley National Wildlife Refuge. Before heading into the classroom, ask the teacher to pair students for this activity. Ask students to sit with their partner in the refuge classroom.

Briefly review with students the proper way to hold and adjust field microscopes. Then pass out one collection kit per team: a Petri dish for specimens, the collection list (a tree bud, seed or seed holder, moss/lichen, bark, and at least one item of their choice) and tweezers. Remind students to collect only enough to look at under a microscope. Emphasize to students to be gentle with the plants they are collecting from; despite winter, many of the plants are still ALIVE.

Specimen Collecting

On refuge, (40 minutes without snowshoes, 60 minutes with snowshoes)

If students have not used snowshoes in the past and will be using them during their collection, briefly introduce snowshoeing concepts including the parts of a snowshoe, how they make walking in snow easier, and how to properly wear them. Show students how to strap on the snowshoes. Lead them outside and demonstrate how to properly stand, walk, and turn. Provide students time to practice to get comfortable using the snowshoes.

Provide students with at least 30 minutes to explore and collect specimens. They will need about 30 minutes in the classroom to view their specimens and complete their journal page.

Specimen Viewing

Back in the classroom provide teams about 30 minutes to look at and observe, under the microscope, the specimens they collected. Suggest to students to use the top of the Petri dish as the slide base under the microscope (they will not be able to use the stage clips). With tweezers from the kit, students should transfer one specimen at a time onto the lid. Remind students the specimens they collected are not flat. Looking through a microscope at a 3-dimensional object can be tricky. Explain to students they will only be able to focus in clearly on one part of the specimen at a time. Reassure students that if parts of the specimens appear blurred, while other parts appear clear, they are doing it correctly. By adjusting the focus slightly they can examine different sections of the specimen.

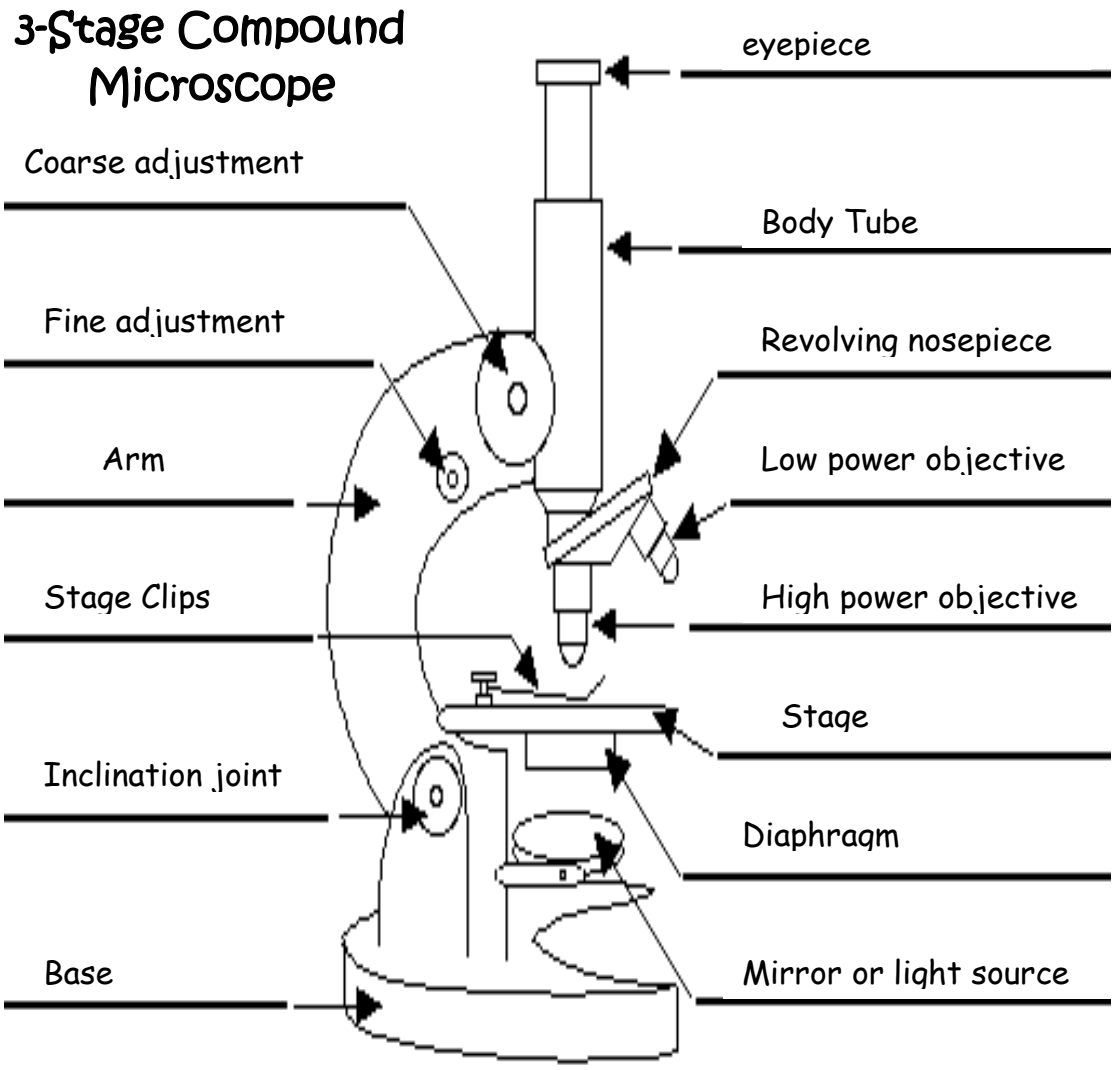
Pass out sheets the student journal pages and colored pencils for students to draw an eye image and a microscope image of at least one specimen they collected and viewed. Ask students to compare and contrast the differences they observe through the two views using their art skills.

As incentive to do their best work on their drawing worksheet, provide students with the opportunity to use even more detailed microscopes. In a separate space set up four compound microscopes, each with one slide specimen for viewing. Rotate eight students, two at each microscope, through in 7-10 minute intervals. A staff or volunteer should begin each rotation with the directions below to ensure students use the microscopes properly.

How to Properly Use a Compound Microscope

1. Begin by turning the base light on. The switch is located on the back of the base. Ask students to figure out how to turn on the upper light (press the switch to the right indicated by a double line) and then the lower or underside light (press the switch to the left indicated by a single line).

2. Demonstrate how to change the magnification lenses. Remind students to hold the microscope firmly by the arm. Note the different colored rings on each lens. A red ring indicates 4X magnification, a green ring indicates 10X magnification and a blue ring indicates 40X magnification. Ask students to always start with the lowest magnification (in this case red) with each slide sample.



3. Encourage students to keep both eyes open while viewing the slide to avoid eye strain. They should focus slowly, using the focusing knobs located on both sides of the arm, to avoid feeling dizzy. When the sample is in sharp focus, then they can switch to the next higher magnification. When they do this they will have to make another slight focusing adjustment. They can repeat this process if every time they move between magnifications.

4. Before students leave, ask that they return the microscopes to the 4X magnification (the red ring).

Wrap-Up Management Connection

Inside the classroom, (30 minutes)

Review the question: Why do biologists use microscopes? Most people think the purpose of a microscope is to look at tiny organisms that we cannot see with our own eyes. Actually, many field biologists use microscopes to examine microscopic (tiny) characteristics of many macroscopic (large) organisms for identification and research.

Ask students to compare the field microscope with the compound microscope. Make a list comparing the two. Which did they think was easier to use? Which would be easier to take into the field? When might a biologist need to make a quick identification in the field? When might a biologist prefer to bring a sample back for an even closer look?

Winter Under a Microscope
Rainy Day Hike Alternatives

Materials

- Field Microscopes- at least one per student pair
- Student Journal Page - one per student
- Petri dish – one per team
- Tweezers – one per team
- Colored pencils- at least one package per team
- 4 compound microscopes
- Set of labeled compound microscope slides (salt, pollen, mouth smear, paramecium)
- Variety of "mystery" specimens pre-collected and sorted into team sets

Introduction

Inside Visitor Center (20 minutes)

Welcome students to Minnesota Valley National Wildlife Refuge. Before heading into the classroom, ask the teacher to pair students for this activity. Ask students to sit with their partner in the refuge classroom.

Briefly review with students the proper way to hold and adjust field microscopes.

Pass out the tweezers, colored pencils, a petri dish, and specimen set to each team. Emphasize to students to be gentle with the specimens so they remain in good condition for other classes.

Instruct students to use the top of the petri dish as the slide base under the microscope (they will not be able to use the stage clips). Transfer one specimen at a time onto the lid with the tweezers.

Remind students that these specimens are not flat. Looking through a microscope at a 3-dimensional object can be tricky. Explain to students they will only be able to focus in clearly on one part of the specimen at a time. Reassure students that if parts of the specimens appear blurred, while other parts appear clear, they are using the microscope correctly.

By adjusting the focus slightly they can examine different sections of the specimen.

Drawing Specimens

On refuge, (30 minutes or more)

Pass out a student journal page to each student. Instruct them to first draw an eye image and then a microscope image of each specimen. Ask students to compare and contrast the differences they observe through the two views using their art skills and write down a set of characteristics they can see for each specimen. What do they think the specimen is?

As incentive to do their best work, and complete as many drawings as time allows, provide students with the opportunity to use even more detailed microscopes. In a separate space set up four compound microscopes, each with one labeled slide specimen for viewing. Rotate eight (two at each microscope) students through in 7-10 minute intervals. A staff or volunteer should begin each rotation with the directions below to ensure students use the microscopes properly.

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3. Encourage students to keep both eyes open while viewing the slide to avoid eye strain. They should focus slowly, using the focusing knobs located on both sides of the arm, to avoid feeling dizzy.

When the sample is in sharp focus, then they can switch to the next higher magnification. When they do this they will have to make another slight focusing adjustment. They can repeat this process if every time they move between magnifications.

4. Before students leave, ask that they return the microscopes to the 4X magnification (the red ring).

Wrap-Up Management Connection

Inside the classroom, (30 minutes)

Have each student team share what they discovered about each specimen. What do they think they were looking at? After all teams have made their guesses, reveal the true identity of each specimen.

Why do biologists use microscopes? Most people think the purpose of a microscope is to look at tiny organisms that we cannot see with our own eyes. Actually, many field biologists use microscopes to examine microscopic (tiny) characteristics of many macroscopic (large) organisms for identification and research. What were some of the microscopic characteristics the students discovered that they would have missed using only their eyes to examine the specimens?

Ask students to compare the field microscope with the compound microscope. Make a list comparing the two. Which did they think was easier to use? Which would be easier to take in the field? When might a biologist choose to make a quick identification? When might a biologist prefer to bring a sample back for closer inspection instead?

Specimen Collecting List

1. Leaf bud
2. Seed or seed holder
3. Moss/Lichen
4. Bark
5. At least one item of their choice

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Microscope Vocabulary

arm - this attaches the eyepiece and body tube to the base.

base - this supports the microscope.

body tube - the tube that supports the eyepiece.

coarse focus adjustment - a knob that makes large adjustments to the focus.

diaphragm - an adjustable opening under the stage, allowing different amounts of light onto the stage.

eyepiece - where you place your eye.

fine focus adjustment - a knob that makes small adjustments to the focus (it is often smaller than the coarse focus knob).

high-power objective - a large lens with high magnifying power.

inclination joint - an adjustable joint that lets the arm tilt at various angles.

low-power objective - a small lens with low magnifying power.

mirror (or light source) - this directs light upwards onto the slide.

revolving nosepiece - the rotating device that holds the objectives (lenses).

stage - the platform on which a slide is placed.

stage clips - metal clips that hold a slide securely onto the stage.

KEY

Label the parts of the compound microscope